DOCUMENT RESUME

ED 062 415 TM 001 583

TITLE	Balance Assembler (clock & watch) 6-72.127; Endshake Adjuster (clock & watch) 8-72.10; Escapement Adjuster (clock & watch) 4-72.120; Hairspring Inspector (clock & watch) I 4-72.205; Hairspring Pinner (clock & watch) 8-72.10; Mechanical Assembler (clock & watch) 6-72.113; Oiler (clock & watch) 6-72.955; Repairman (clock & watch) 4-72.960; Timing-Machine Operator (clock & watch) 6-72.248; Train Inspector (clock & watch) 4-72.206; (Movement Assembly Department)--Technical Report on Standardization
REPORT NO	TR-S-151
PUB DATE	Mar 59
NOTE	11p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Aptitude Tests; Assembly (Manufacturing); *Cutting Scores; Evaluation Criteria; Job Applicants; *Job Skills; Norms; Occupational Guidance; *Personnel Evaluation; Skilled Occupations; Test Reliability; Test Validity; *Watchmakers
IDENTIFIERS	Clock and Watch Movement Assembly Department; GATB; *General Aptitude Test Battery

ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is also included. (AG)

FILMED FROM BEST AVAILABLE COPY

ED 062415

TECHNICAL REPORT

ON

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

BALANCE ASSEMBLER (clock & watch) 6-72.127
ENDSHAKE ADJUSTER (clock & watch) 8-72.10
ESCAPEMENT ADJUSTER (clock & watch) 4-72.120
HAIRSPRING INSPECTOR (clock & watch) I 4-72.205
HAIRSPRING PINNER (clock & watch) 8-72.10
MECHANICAL ASSEMBLER (clock & watch) 6-72.113
OILER (clock & watch) 6-72.955
REPAIRMAN (clock & watch) 4-72.960
TIMING-MACHINE OPERATOR (clock & watch) 6-72.248
TRAIN INSPECTOR (clock & watch) 4-72.206

(MOVEMENT ASSEMBLY DEPARTMENT)

B-415
or
S-151

EM OCT 63

U. S. Employment Service in
Cooperation with
Texas State Employment Service

U. S. DEPARTMENT OF LABOR
Bureau of Employment Security
Washington 25, D. C.
March 1959

FILMED FROM BEST AVAILABLE COPY

GATB #2216
February 1958

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY FOR WATCH ASSEMBLY OCCUPATIONS IN THE MOVEMENT ASSEMBLY DEPARTMENT

B-415 or S-151

Summary

The General Aptitude Test Battery, B-1002A, was administered to a sample of 63 women employed in the Movement Assembly Department at the U. S. Time Company, Abilene, Texas. The occupations covered in the Movement Assembly Department are as follows:

Balance Assembler 6-72.127
Endshake Adjuster 8-72.10
Escapement Adjuster 4-72.120
Hairspring Inspector I 4-72.205
Hairspring Pinner 8-72.10
Mechanical Assembler 6-72.113
Oiler 6-72.955
Repairman 4-72.260
Timing-Machine Operator 6-72.248
Train Inspector 4-72.206

The criterion consisted of broad category supervisory ratings. On the basis of mean scores, correlations with the criterion, job analysis data, and their combined selective efficiency, Aptitudes S-Spatial Aptitude, P-Form Perception, and F-Finger Dexterity were selected for inclusion in the test norms.

GATB Norms for Watch Assembly Occupations in the Movement Assembly Department B-415 or S-151

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for Watch Assembly Occupations in the Movement Assembly Department.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for B-415 or S-153

B-1001			B-1002		
Aptitude	Tests	Minimum Acceptable Aptitude Score	Aptitude	Tests	Minimum Acceptable Aptitude Score
S	CB-1-F CB-1-H	90	S	Part 3	85
P	CB-1-A CB-1-L	90	P	Part 5 Part 7	90
F	CB-1-O CB-1-P	[illegible]	F	Part 11 Part 12	90

FILMED FROM BEST AVAILABLE COPY

Effectiveness of Norms

The data in Table IV indicate that 17 of the 22 poor workers, or 77 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 77 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 37 of the 42 workers who made qualifying test scores, or 88 percent, were good workers.

FILMED FROM BEST AVAILABLE COPY

TECHNICAL REPORT

I. Problem

This study was conducted to determine the best combination of aptitudes and minimum scores to be used as norms on the General Aptitude Test Battery for Watch Assembly Occupations in the Movement Assembly Department.

II. Sample

The General Aptitude Test Battery, B-1002A, was administered during the period December 10, 1957 to February 10, 1958 to a sample of 63 women employed in the Movement Assembly Department, U. S. Time Company, Abilene, Texas. These workers were shifted about in the entire Movement Assembly Department. All the workers had completed an on-the-job training program.

Table II shows the means, standard deviations, ranges, and Pearson product-moment correlations (corrected for broad categories) with the criterion for age, education, and experience.

TABLE II

Means (M), Standard Deviations (σ), Ranges, and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion (c^r) for Age, Education, and Experience

Watch Assembly Occupations in the
Movement Assembly Department
N = 63

	M	σ	Range	c^r
Age (years)	26.9	7.0	17-46	-.190
Education (years)	10.8	1.4	8-13	.073
Experience (months)	25.7	23.4	2-100	.112

There are no significant correlations between age, education, or experience and the criterion. The data in Table II indicate that the sample is suitable for test development purposes with respect to age, education, and experience.

III. Job Descriptions

Job Titles: Balance Assembler 6-72.127
Endshake Adjuster 8-72.10
Escapement Adjuster 4-72.120
Hairspring Inspector I 4-72.205
Hairspring Pinner 8-72.10
Mechanical Assembler 6-72.113
Oiler 6-72.955
Repairman 4-72.[illegible]
Timing-Machine Operator 6-72.248
Train Inspector 4-72.206

FILMED FROM BEST AVAILABLE COPY

BALANCE ASSEMBLER
Job Summary: Inserts balance wheel in watch movement.

Work Performed: Removes watch movement from carrier and places it in a metal block with compartment to hold watch movement and recess for crown to fit in, with front up. Loosens balance screw using jeweler's screwdriver with left hand. Picks up balance wheel from tray using tweezers. Checks to see that end of hair spring is opposite part of wheel hold with tweezers. Turns balance wheel over and checks to see that impulse pin is on left side of wheel. Rejects wheel if impulse pin is not on left. Inserts balance wheel in movement and inserts top end of staff in balance screw cup and bottom end of staff in back cup. Tightens balance screw and tests endshake of balance wheel to determine when balance screw is tight enough. Removes movement from balance wheel stand. Replaces it in carrier and places carrier on conveyor belt.

ENDSHAKE ADJUSTER
Job Summary: Adjusts endshake of balance wheel using a machine which tightens the balance screw to adjust endshake balance wheel.

Work Performed: Takes watch movement in carrier from conveyor belt. Removes movement from carrier and places it face down in nest (holding compartment) of endshake machine. Shoves pneumatic lever to right to lower top of block into movement and move slide in under balance wheel. Flips lever to raise screwdriver blade in block and engage it with balance screw stud. Looks into scope of machine and presses down on spring loaded lever to raise balance wheel. Turns jack screw to move mounting stage up and down until top edge of balance staff roller is in line with the "set" line scribed on screen in scope. Removes finger from spring loaded lever to lower balance wheel. Turns screwdriver knurled wheel until screwdriver blade engages in balance screw slot. Continues to turn wheel until top edge of balance staff roller is between .0007 and .0009 lines on screen of scope. Flips lever to disengage screwdriver. Pushes air lever to raise top of block and pull slide away from movement. Removes movement from nest and places it in carrier. Places carrier on conveyor belt.

ESCAPEMENT ADJUSTER
Job Summary: Checks and adjusts escapement in watch movement using assembly tools.

Work Performed: Takes watch movement, in carrier, from table and places it on stand. Removes movement from carrier and holds it to allow sighting through movement to check engagement of pallet pins with escape wheel teeth while actuating the balance wheel. Straightens bent pallet pins by catching pin in fork of pallet tool and rolling tool slightly to right or left. Checks clearance between guard pin and safety roller by sighting through movement from right side and left side of movement. Checks and straightens bent pallet pin with pallet lever adjusting tool. Checks guard pin light using loupe. Bends guard pin very slightly using tweezers when clearance needs to be increased. May replace escapement parts using jeweler's screwdriver, tweezers, pallet lever tool and pin straightener. Uses loupe while checking and making repairs.

FILMED FROM BEST AVAILABLE COPY

HAIRSPRING INSPECTOR I
Job Summary: Checks watch movement hairspring for needed adjustments and makes adjustments.

Work Performed: Removes watch movement, in carrier, from conveyor belt and places it on stand. Removes movement from carrier. Holds movement at an angle to enable sighting along hairspring and through regulator loop moving regulator toward slow position. Holds outer coil of hairspring close to pinning point with tweezers and bends hairspring up or down by turning tweezers to raise or lower hairspring in regulator loop. Holds hairspring close to pinning point and bends it to adjust level of hairspring up or down. Moves regulator to fast and center positions and repeats checking and adjustment process. Holds movement at an angle and looks through back frame to check hairspring for centering and clash while rolling balance wheel back and forth. Adjusts hairspring along outer coil to produce center effect or to eliminate clash. Checks for centering and clash by looking into movement from back of movement. Rechecks for vibration and leveling. Replaces movement in carrier and places carrier on conveyor belt.

HAIRSPRING PINNER
Job Summary: Pins hairspring to pinning bracket using tweezers.

Work Performed: Takes watch movement in carrier from conveyor belt and places it on stand. Removes movement from carrier and moves regulator point right half way between fast and slow set using tweezers. Reaches into movement with tweezers and rolls balance wheel clockwise or counter-clockwise to engage impulse pin on balance wheel into pallet lever fork. Picks up end of hairsprings. Threads hairspring through hole in regulator point and pulls it through. Places end of hairspring in hole in pinning bracket. Picks up small wedge pin with tweezers and places it in hold in pinning bracket with hairspring. Pushes wedge pins tight in hole by pressing on end with tweezers. Replaces movement in carrier and places carrier on conveyor belt. Uses loupe. May replace faulty regulators.

MECHANICAL ASSEMBLER
Job Summary: Assembles back plate of movement, placing third and fourth wheels, set lever of watch, black and silver bridges with winding pinion inserted between bridges, pallet lever and escape wheel to meet fourth wheel, and center wheel over barrel in movement so cogs of center wheel will mesh with center wheel. Assembles front of frame on assembly in block so pivots of train wheels come through holes in front frame; lifts center wheel so it clears pivot hole; and holding movement in place with index finger, inverts block and tightens screws with a jeweler's screwdriver.

Work Performed: Places four screws, heads down, in holes in block; places back plate of movement flat in block fitting holes in back plate over screws. Places third wheel in place on back plate of movement and pushes third wheel slide of block in toward center of block to hold third wheel in place; places fourth wheel on back plate of movement and pushes fourth wheel slide in toward center of block to hold fourth wheel in place; places set lever (used to set watch) in place on movement backplate and pushes bridge slide of block in toward center of block to hold set lever; places black bridge and silver bridge in place in movement and inserts the winding pinion in between the two

FILMED FROM BEST AVAILABLE COPY

bridges. Places tubular pillar in frame and pushes pallet lever slide of block in toward center of block to hold pieces in place. Places pallet lever and escape wheel in movement to meet fourth wheel; places barrel in movement and then places center wheel over barrel so its cogs will mesh with third wheel. Places front of frame on assembly in block so that pivots of train wheels will come through holes in front frame. Lifts center wheel gently to see that it clears front frame pivot hole. Picks up block, holds movement in place with index finger, inverts block and tightens four screws through holes in bottom of block using a jeweler's screwdriver. Retracts block slides and removes the assembled movement from block. Places movement in tray on table.

OILER
Job Summary: Oils back cup, balance cup, and three teeth on escape wheel using an oiler.

Work Performed: Takes tray of watch movements in carriers from work bench and empties tray on stand. Removes movement from carrier and places it in vacuum slot on back edge of stand. Removes movement from vacuum slot and replaces it with another movement. Holds and turns movement and places a speck of oil in the back cup and balance cup and on three teeth of escape wheel using an oiler. Checks for proper oiling and rejects movements that have too much oil, placing them in tray for cleaning. Uses a loupe to see parts to be oiled and while performing oiling operation. Places oiled watches back in carrier and places carrier on conveyor belt.

REPAIRMAN
Job Summary: Replaces defective wheels, barrels, bridges, winding pinions, retaining springs, crowns and set levers in watch movements.

Work Performed: Obtaines defective watch movements. Reaches across conveyor belt (approximately two feet) and picks up tray of defective watch movements or asks test train to hand tray across conveyor belt. Removes movement from tray and places it on stand. Looks at marking on movement to determine part to be replaced or repaired. Pry's back and front of movement apart to enable getting tweezers into movement to remove defective part and to replace it with non-defective part. May remove pillar screws using a jeweler's screwdriver to enable removal of some parts. Replaces pillar screws when parts have been replaced. Uses fourth wheel tool to remove fourth wheels and the clean third wheels. Uses stick wheel tool to clean burrs off holes in movement. Uses friction pliers to squeeze cannon pinion to lessen the friction of cannon pinion. Uses pallet lever tool to pry movement frame apart while changing pallet lever. Performs test train operation after repair work is completed to ascertain function of movement. Uses loupe while working on movement. Places movement in winder and winds it. Places movement in carrier and places carrier in tray. Keeps record of parts change and movements that cannot be repaired by making tally marks on error tally sheet.

TIMING-MACHINE OPERATOR
Job Summary: Regulates watch movement using an electronic timer.

FILMED FROM BEST AVAILABLE COPY

Work Performed: Takes watch movement from movement tray. Sets regulator about center, places movement in mike holder of electronic timer with crown on left and front side facing out. Sets zero on dial of electronic timer on steadiest flash on dial by turning dial with fingers. Presses button to turn on green light and start timing interval. Watches flash on dial to see that it stays in between "1" and "3" dial workings until red light comes on indicating end of checking interval. Resets regulator and resets checks if flashes do not remain between "1" and "3" workings on dial. Removes movement from holds. Separates rejects by slows, fasts, erratics, defective hairsprings and stoppers, and places them in separate plastic trays. Separates fasts by different conveyors.

TRAIN INSPECTOR
Job Summary: Checks movement assembly for malfunction and defective parts.

Work Performed: Takes movement, in carrier, from conveyor belt. Removes movement from carrier and places it on a pedestal type plastic platform which is adjustable to height desired by operator. Picks up movement and examines outside of movement with naked eye to detect defective parts and workmanship. Turns movement in hand to facilitate checking inside of movement using loupe. Uses tweezers and screwdriver to test trueness, end shake, tension, looseness, and stickiness of wheels, pinions, main arbor, and pallet lever. Inserts movement in mechanical winder and winds to check action of crown and stem assembly alignment with barrel assembly. Detects any faulty mechanism, parts, or assembly; makes minor repairs or places movement in container to be sent to repair. Places movements that pass inspection in trays on work bench. Tallies defects of faulty parts or workmanship on error sheet and places symbol on watch movement with pencil to indicate needed repair.

IV. Experimental Battery

All the tests of the GATB, B-1002A, were administered to the sample group.

V. Criterion

The criterion for this study consisted of broad category supervisory ratings. The Movement Assembly Department foreman and the plant superintendent rated each worker on her ability to perform her duties in jobs in the Movement Assembly Department. The rating was a composite overall evaluation by the foreman and the plant superintendent. The workers were placed in one of three categories--"good," "average," or "poor." This placed 21 workers in the "good" group, 20 in the "average" group, and 22 in the "poor" group. For computational purposes the qualitative ratings were converted to quantitative scores of 61, 50, and 39 for the good, average, and poor groups, respectively.

VI. Statistical and Qualitative Analyses

A. Statistical Analysis:

Table III shows the means, standard deviations, and Pearson product-moment correlations (corrected for broad categories) with the criterion for the aptitudes of the GATB. The means and standard deviations of the aptitudes are comparable to general working population norms with a mean of 100 and a standard deviation of 20.

FILMED FROM BEST AVAILABLE COPY

Means (M), Standard Deviations (σ), and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion ($_{c}r$) for the Aptitudes of the GATB

Watch Assembly Occupations in the Movement Assembly Department

Aptitudes	M	σ	$_{c}r$
G-Intelligence	96.3	12.7	.291*
V-Verbal Aptitude	96.1	13.4	.241
N-Numerical Aptitude	91.3	13.1	.342**
S-Spatial Aptitude	103.3#	15.8	.114
P-Form Perception	103.9#	14.5	.538**
Q-Clerical Perception	103.0	12.4	.349**
K-Motor Coordination	102.8	13.9	.247
F-Finger Dexterity	103.8#	17.0	.475**
M-Manual Dexterity	101.0	16.4	.390**

** Significant at the .01 level
* Significant at the .05 level
# Relatively high mean score

The highest mean scores in descending order of magnitude were obtained for Aptitudes P, F, and S, respectively. All the aptitudes have standard deviations of less than 20. Aptitude Q has the lowest standard deviation.

For a sample of 63 cases, correlations of .323 and .248 are significant at the .01 level and the .05 level of confidence, respectively. Aptitudes N, P, Q, F, and M correlate significantly with the criterion at the .01 level. Aptitude G correlates significantly with the criterion at the .05 level.

B. Qualitative Analysis:

The statistical results were interpreted in the light of the job analysis data. The job analysis indicated that the following aptitudes measured by the GATB appear to be important for this occupation.

Spatial Aptitude (S) and Form Perception (F) - required to detect defective and malfunctioning parts and make replacement of defective parts.

Motor Coordination (K), Finger Dexterity (F), and Manual Dexterity (M) - required to work rapidly and accurately with hands while watching adjustment through scope; to handle tweezers and jeweler's screwdriver rapidly and accurately to check parts and to make repairs.

FILMED FROM BEST AVAILABLE COPY

C. Selection of Test Norms:

Based on the quantitative and qualitative evidence cited above, Aptitudes S, P, F, and M warranted further consideration for inclusion in the test norms. The evidence for each of these aptitudes is indicated below.

Aptitude	High Mean Score	Significant Correlation with the Criterion	Importance Indicated by Qualitative Analysis
S	X		X
P	X	X	X
F	X	X	X
M		X	X

Although Aptitudes G and N showed significant correlations with the criterion, these aptitudes were not considered further for inclusion in the norms because there was no other quantitative and qualitative evidence of significance. Although Aptitude Q had a significant correlation with the criterion and had other quantitative evidence in its mean score and standard deviation, it was eliminated from further consideration in favor of Aptitude P which had more quantitative and qualitative evidence of significance.

Various combinations of Aptitudes S, P, F, and M, with appropriate cutting scores were selected as trial norms. The relationship between each set of trial norms and the criterion (dichotomized as indicated in section VII) was determined.

A comparison of the results showed that B-1002 norms consisting of S-85, P-90, and F-90 had the best selective efficiency.

In test development studies an attempt is made to develop a set of norms such that the cutting score for each aptitude included in the norms will be set at a five-point score level close to one standard deviation below the aptitude mean of the experimental sample. Adjustments of cutting scores from one standard deviation below the mean are made to effect better selective efficiency of the norms. In this study the aptitude cutting scores are each within 5 points of one standard deviation below the aptitude mean of the sample.

VII. Concurrent Validity of Norms

For the purpose of computing the tetrachoric correlation coefficient between the test norms and the criterion and applying the Chi Square test, the criterion was dichotomized with those workers rated as Good and Average placed in the high criterion group, and with those rated as Poor placed in the low criterion group. This resulted in 22 of the 63 workers, or 35 percent of the sample, being placed in the low criterion group.

FILMED FROM BEST AVAILABLE COPY

Table IV shows the relationship between test norms consisting of Aptitudes S, P, and F with critical scores of 85, 90, and 90, respectively, and the dichotomized criterion for Watch Assembly Occupations in the Movement Assembly Department. Workers in the high criterion group have been designated as "good workers" and those in the low criterion group as "poor workers."

TABLE IV

Relationship between Test Norms Consisting of Aptitudes S, P, and F with Critical Scores of 85, 90, and 90, Respectively, and the Criterion for Watch Assembly Occupations in the Movement Assembly Department

N = 63

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	4	37	41
Poor Workers	17	5	22
Total	21	42	63

$r_{tet} = .89$ $\qquad$ $X^2 = 26.4$

$\sigma_{r_{tet}} = .21$ $\qquad$ $P/2 < .0005$

The data in the above table indicate a significant relationship between the test norms and the criterion for the sample.

VIII. Conclusions

On the basis of mean scores, correlations with the criterion, job analysis data, and their combined selective efficiency, Aptitudes S, P, and F with minimum scores of 85, 90, and 90, respectively, are recommended as B-1002 norms for Watch Assembly Occupations in the Movement Assembly Department. The equivalent B-1001 norms consist of S-90, P-90, and F-95.

IX. Determination of Occupational Aptitude Pattern

When the specific test norms for an occupation include three aptitudes, only those occupational aptitude patterns which include the same three aptitudes with cutting scores that are within 10 points of the cutting scores established for the specific norms are considered for that occupation. The only one of the existing 23 occupational aptitude patterns which meets these criteria for this study is OAP-22 which consists of S-85, P-90, and F-85 for B-1002 and S-90, P-90, and F-90 for B-1001. The selective efficiency of OAP-22 for this sample was determined by means of the tetrachoric correlation technique. A tetrachoric correlation of .84 with a standard error of .21 was obtained, which indicates a significant relationship between OAP-22 and the criterion for this experimental sample. The proportion of the sample screened out by OAP-22 was .30, which is within the required range of .10 to .60. Therefore, it is recommended that OAP-22 be used in counseling for Watch Assembly Occupations in the Movement Assembly Department.